

Migration, Internal

MIGRATION FLOWS AND THEIR DETERMINANTS,
AND THE EFFECTS OF RETURN MIGRATION*

by

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Vancouver, (Discussion Paper 22)
Department of Economics,
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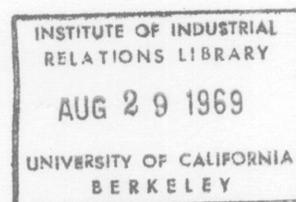
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Note: This is a preliminary draft.

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Introduction

The analysis of migration flows is naturally concerned with the relationships between migration and such variables as incomes or income differentials, employment opportunities and distance. But before this can proceed a prior question needs to be answered first, whether to study gross or net migration flows. It is commonplace to observe that gross migration flows are typically far greater than the corresponding net flows. Little explanation is provided for this observation and not much guidance is therefore available in the choice of the dependent variable. The choice is generally based on convenience, e.g., related to the availability of data, or on rather arbitrary inclinations of the investigator.¹

This paper examines at the theoretical level the distinction between three types of migration flows: new migration, return migration, and autonomous migration. The implications of this distinction are shown to be important and quite pervasive. We can explain the relative magnitudes of gross and net migration flows, and it becomes complicated to use estimated coefficients in determining the trade-off relation between income and distance. Return migration, which an earlier study showed to be quantitatively important, has the effect of linking gross migration flows in opposite directions. This creates the econometric problem of simultaneity which is dealt with here by estimating reduced form equations. Looked at from this vantage point it becomes impossible to give a unique interpretation of an estimated relation between net migration and income differentials.

The proportion of return migrants is likely to vary negatively with the level of economic activity while employment opportunities which

¹ See e.g., R. Marvin McInnis, "Provincial Migration and Differential Economic Opportunity", Mimeo, 1968. A major exception is, of course, L. Sjaastad, "The Costs and Returns of Human Migration", Journal of Political Economy LXX No. 5 October 1962 Supplement. I shall return to his contribution below.

vary with the state of the labour market are likely to result in income prospects (and parameters) which vary with the level of economic activity. This means that for these two reasons the income and distance coefficients in the estimating equations will vary strongly with business activity. And this is confirmed by the empirical results. Thus not only is the overall level of migration reduced under depressed economic conditions, but the "allocative efficiency" of migration is also adversely affected. This has obvious implications for stabilization policy as well as mobility policy. It also means that the time period covered by a migration study will have a significant influence on the tests of hypotheses and on the estimates of coefficients. Finally, the estimates of costs and benefits associated with regional mobility will be affected by the interpretation of the estimated parameters.

In short the distinction between the three types of migration flows not only tells us something about the choice of dependent variable, it also determines the form in which the basic relationship should be tested and estimated, and it guides us in the interpretation of empirical results.

The paper is divided into seven sections. The theoretical problems are discussed in Section 2 below. Some alternative theoretical hypotheses are considered and evaluated in the third section. Section 4 together with Appendices A and B describe the sources of data. The empirical results are reported in Section 5 (and Appendix C) and their implications are considered in Section 6.

Theoretical Problems

The general theoretical hypothesis to be examined in this paper is that migration between two regions is largely determined by the average incomes in the two regions and by the distance between them. The common use of income differentials as the main explanatory variable is, of course, only a special case of our more general hypothesis. Some alternative hypotheses linking migration to employment opportunities in the two regions are briefly considered in the next section.

It is useful to distinguish between three types of migration flows:

- (i) new migration (NM_{ij})
- (ii) return migration (RM_{ij}) and
- (iii) autonomous migration (AM_{ij});

i denotes the sending region and j the receiving region. Return migration consists of those people who are returning to their home territory, which is some proportion of other migration flows in the opposite direction ($NM_{ji} + AM_{ji}$). The flow of autonomous migration constitutes all those moves which are unrelated to average incomes in the regions such as employment transfers within business firms, government agencies and the armed forces. It may be presumed that all three migration flows are related to distance. This is a very reasonable assumption with regard to new and return migration flows, but it may also be argued that *ceteris paribus* (and these other things relate to the regions' industrial and occupational make-up) autonomous migration is a function of distance since distance raises the costs of employment transfers.

In linear equation form we can write

$$(1) \quad NM_{ij} = a_0 + a_1 Y_j + a_2 Y_i + a_3 D$$

$$(2) \quad RM_{ij} = k(NM_{ji} + AM_{ji}) + b_1 D$$

$$(3) \quad AM_{ij} = c_0 + c_1 D$$

Distance is represented by D and incomes by the Y variables. The linear form is at present simply chosen for convenience. The actual specification of the relationships to be estimated will be the main topic of discussion in this section of the paper.

The distance variable will no doubt have a negative influence on all three migration flows; in other words, parameters a_3 , b_1 and c_1 are all expected to be negative. As a variable distance, of course, does not only represent the transport costs associated with distance but it in fact represents three separate factors associated with geographical mobility.

- a) the money costs connected with moving;
- b) the psychic costs of moving; and
- c) the difference in psychic incomes associated with with sender and receiver regions.

The distinction between (b) and (c) is somewhat artificial but nevertheless very useful. Under (b) we would classify those costs which do not recur after the move has been completed, whereas (c) includes psychic costs which are permanent. The psychic cost associated with the actual move belongs under (b) but also the cost of adjusting to new surroundings and new acquaintances. But the ongoing preferences for the surroundings and people of one region compared with another belong under (c). Factors (a) and (b) are clearly related to distance, but factor (c) may also be influenced by distance since the greater the distance the larger are the actual costs associated with subsequent visits to the region of "origin"; thus the longer is the move away from "home" the less likely are return visits home. This introduces a somewhat alien element since ideally distance should only represent the costs of adjustment connected with a move. It makes the interpretation of the empirical estimates more complicated.²

² Cf. L.A. Sfaastad, op. cit., pp. 83 and 84.

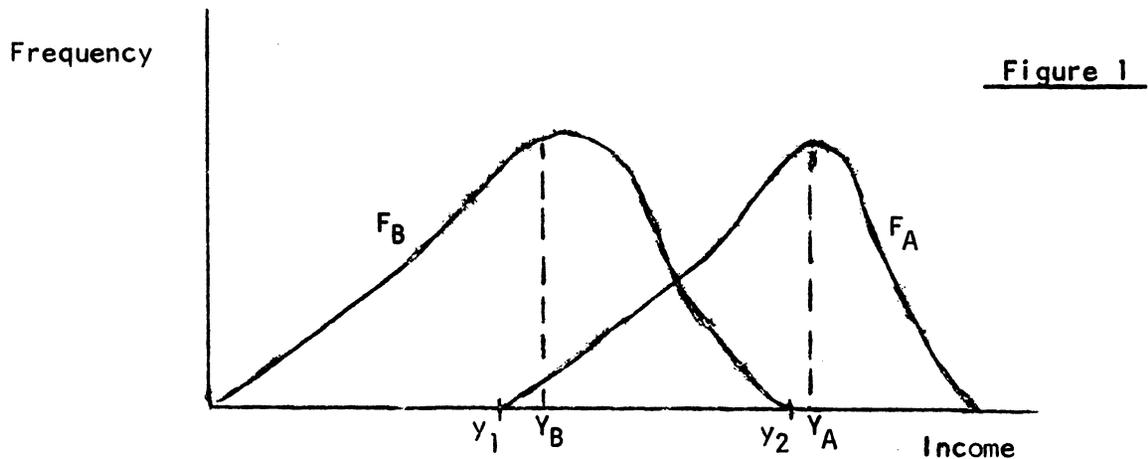
Factors (a) and (b) will probably contain a quite sizeable element of fixed costs and possibly also declining marginal costs with increasing distance. Even if the relation between migration and moving costs is linear, the relationship between migration and distance may well be non-linear. In particular, the relation between migration and distance will have a negative slope but it is quite likely that this slope becomes less negative with distance (i.e., the second derivative is positive).³ There is, however, in addition a statistical reason why we may observe a relationship of this shape. Distance is measured by the mileage between the main centres of the various regions (See Appendix B). In the case of Canada's geography this means that the shortest distances are registered for pairs of contiguous regions. For obvious reasons our distance variable may well overestimate the real distance covered by migrants between contiguous regions. This will tend to increase the degree of non-linearity in the migration-distance relation.

Next we turn our attention to the relation between income and new migration flows (equation (1)). For the moment, we shall look at the income variables Y_j and Y_i purely in terms of the monetary returns of migration. These variables represent average incomes in the two regions, on the presumption that for the typical person the income alternatives are similar to the average incomes. Migration flows are, however, by no means homogeneous, and groups of migrants may have different occupational or industrial attachments, a different age structure, and follow different career paths. Since disaggregation is not possible with our empirical data, we can only take account of this heterogeneity in the general specification. Now, if region A has higher average income

³ If C represents moving costs we can write, e.g., $M = l_0 - l_1 C$ (omitting other variables) and $C = m_0 - m_1 1/D$, with all parameters positive. Then $M = (l_0 - l_1 m_0) + l_1 m_1 1/D$. Cf. Marvin McInnis, op. cit., p. 99.

than region B, it may still be true that for most people their individual income opportunities are better in A than in B. But it clearly remains possible that for some people region B offers better income opportunities than region A, thus making it possible to observe an induced migration flow from A to B.⁴

Under these circumstances we may formulate the migration-income relation in the following hypothesis: the higher is the average income in region A compared with B the more likely is it that persons in region B have better income opportunities in A and migrate to A, and the less likely is it that persons in A have better income opportunities in B and move to B. This is illustrated in Figure 1.



The frequency distributions F_A and F_B around the regional income averages Y_A and Y_B respectively may be thought of as the actual income distributions in the two regions. Even with a considerably higher average income in region A there are still many people in A in the income range $Y_1 - Y_2$ who may potentially have better income opportunities in region B. It is quite likely that the resulting relationship between new migration flows and incomes will be non-linear. In our example relating to Figure 1

⁴ Marvin McInnis, *op. cit.*, pp. 122-125, calls this kind of migration flow in the wrong direction. This clearly implies a very simple specification of the theory, and it forms his main reason for working with net rather than gross migration.

the migration flow from A to B may be quite small, and with a larger Y_A it may even be smaller but it can by its nature never be less than zero. An exponential function may express this relationship more adequately than a simple linear one.

Still continuing to look at the income variables in terms of the monetary returns to migration, we may conclude that Y_j should have a positive effect on NM_{ij} and Y_i should have a negative effect. In other words, in the simple linear form of equation (1) coefficients a_1 and a_2 should be positive and negative respectively. If a_1 and a_2 also have the same absolute size then we can simplify our specification in terms of a single income differential variable.

Income in the sender region (Y_i), in addition to being an element in the calculation of returns to migration, may also play a role as a source of financing migration decisions. The potential migrant has to think about the problem of financing his move which not only involves transport expenses but also costs associated with leaving one place and settling again in another. Moreover he may also wish to allow for the possible expense of returning if he might be disappointed about his original decisions. The higher average income is, the more likely will the typical potential migrant be able to finance his move. From this viewpoint alone there will therefore be a positive relationship between the new migration flow and income in the sender region. Combined with the point of the previous paragraph this means that the absolute size of the Y_i coefficient is likely to be smaller compared with the Y_j parameter; a_2 may still be negative, or zero, or even positive. This also implies that a specification with an income differential as explanatory variable is likely to be incorrect.

Since income prospects vary with employment opportunities the income parameters are likely to vary with the state of the labour market. Thus when the labour markets develop slack, while average incomes change little, the income prospects particularly in potential receiving regions are markedly reduced. Migration will decline in response to these reduced income prospects, which means that the income parameters will become smaller. We should therefore expect to find that the (absolute) size of the income coefficients (and particularly the Y_j parameter) will turn out to fluctuate with the cyclical pattern of the labour market.

The foregoing theoretical arguments have an important bearing on the specification of the model and on the interpretation of the results. As the empirical data do not allow any disaggregation we shall first combine the three theoretical equations.

$$(4) M_{ij} = (a_0 + c_0)(1+k) + (a_1 + ka_2)Y_j + (ka_1 + a_2)Y_i + \{ (a_3 + c_1)(1+k) + b_1 \} D$$

This will be recognized as a reduced form equation which incorporates equations similar to (1) and (3) for new and autonomous migration from regions j to i . Return migration creates a simultaneous relationship between the migration flows in opposite directions and the reduced form is an estimating equation which explicitly eliminates this simultaneity. An alternative procedure (which is explained in Appendix A) is to calculate an estimate of average return migration and to use this as an explanatory variable. Since this is a less desirable procedure, as it does not really eliminate the simultaneity problem, the results of this estimating procedure are relegated to Appendix C.

Before we turn to statistical estimation a number of implications of this theoretical discussion need to be considered. The income and distance coefficients in equation (4) are all complex coefficients.

While it is impossible to disentangle these coefficients in the estimation of this equation it is possible to make certain generalizations. We may be interested in the trade-off between incomes and distance in order to evaluate mobility policies. For this purpose the coefficients of equation (4) produce an exaggerated picture since the distance coefficient will be overestimated (in absolute size) and the income coefficients will tend to be underestimated. To calculate this distance-income trade-off we should be using the coefficients of equation (1) rather than those of (4). All coefficients are affected by the return migration parameter k . If a_1 is positive and a_2 negative then the income coefficients will both be smaller in absolute size than the original parameters. The distance coefficient is, furthermore, a summation of the three distance parameters (a_3 , b_1 and c_1) in equation (1), (2) and (3), all of which are presumed negative. We shall return to this trade-off question in Section 6 below.

It was discussed above that estimates of the income coefficients in equation (1) may be expected to vary with the state of the labour market. In the reduced form of equation (4) there is an additional reason for such variations in the Y_j and Y_i coefficients introduced by the return migration coefficient k . This k -coefficient is expected to vary negatively with the state of the labour market, since a larger number of people are likely to be disappointed about their migration decision when there is an excess supply of labour. If a_1 is positive and a_2 is negative (but absolutely smaller than a_1) then the Y_j coefficient in (4) will be positive but smaller in depressed labour market conditions (when k is large) than in prosperous conditions (k small). Under these circumstances the sign of the Y_i coefficient in equation (4) would be

uncertain and we should not be surprised if it turns out to be positive.⁵

Since it is likely that coefficients will vary with economic conditions, the choice of a time period for which a migration model will be tested and estimated is likely to be very important. By the same argument the allocative efficiency of migration may well vary with economic conditions. In other words, the income-distance trade off is quite likely to vary with the state of the labour market producing higher rates of return to mobility under favourable economic conditions than during depressions.

To discuss the relationship between gross and net migration flows we define a ratio (r) which expresses net migration flow between regions i and j in terms of the sum of the gross flows. Let j be the more attractive region so that net migration into j is positive; for convenience I assume for this purpose that the b_1 coefficient of distance in the return migration equation (2) equals zero. The ratio r can then be expressed as follows

$$(5) \quad r = \frac{M_{ij} - M_{ji}}{M_{ij} + M_{ji}} = \frac{(1-k)\{NM_{ij} + AM_{ij} - (NM_{ji} + AM_{ji})\}}{(1+k)\{NM_{ij} + AM_{ij} + NM_{ji} + AM_{ji}\}}$$

It is clear that the ratio r will equal unity only if the migration flow to the less attractive region, M_{ji} , equals zero. As soon as we permit return migration this picture changes and r becomes a fraction dependent upon k . Suppose $k=.5$ but aside from return migration there is no mobility from j to i ($NM_{ji} + AM_{ji} = 0$), then $r = 1/3$. It is easy to see that the ratio becomes even smaller when NM_{ji} and AM_{ji} are no longer zero. For example, if $k = .5$, $AM_{ij} = AM_{ji} = 100$, $NM_{ij} = 500$, and $NM_{ji} = 200$,

⁵Take, for example, $a_1 = .3$ and $a_2 = -.1$ while $k = .5$ then the Y_j coefficient in (4) will be $+.25$ and the Y_i coefficient in (4) will be $+.05$.

then $r = 1/9$. Thus even when region j is far more attractive to new migrants from i than region i to new migrants from j , the net migration flow is only a small fraction of the gross flows. For the migration data used below the average ratio r appears to be about $1/8$. It is quite consistent with the income hypothesis advanced above that there should still be a gross migration flow from region j to region i despite the fact that region i has the lower average income. As a corollary it follows that we should also expect gross flows between regions the average incomes of which are about the same, and that for such pairs of regions the ratio r is likely to be a small fraction indeed. This is, in fact, the case for the migration data used, e.g. r is about $1/11$ for the ten pairs of regions with less than \$400 income differentials.

If we were to estimate the relationship between net migration flows and the income and distance variables, we would obtain the following equation from (4)

$$(6) \quad M_{ij} - M_{ji} = (a_1 + ka_2)(Y_j - Y_i) + (ka_1 + a_2)(Y_i - Y_j)$$

It will be noted that there is no constant term or distance variable in this equation, but this is the result of using the simple linear form of equations (1) - (3). If we choose a non-linear equation form for (1) in which distance and income variables interact, then distance will also appear as a determinant of net migration flows.⁶ Such an equation

⁶A constant term may result from the difficulty of specifying a non-linear relationship. For example, if the relation between migration and income differentials for a given distance is as pictured in the top half of Figure 2, because migration flows are at a minimum equal to Am , then the net migration relationship will have the kinked appearance of the lower half of this figure. As we do not know the location of point a at which the kink occurs, it may be necessary to specify a linear net migration equation which is then likely to have a positive constant term.

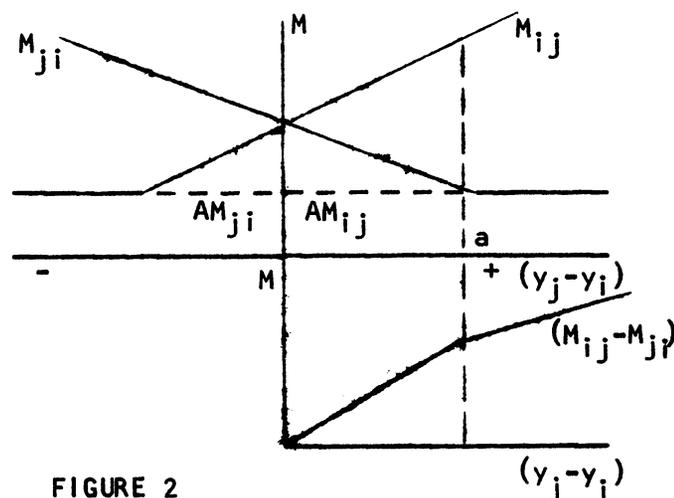


FIGURE 2

form is in fact chosen in the estimation on the ground that the effect of income on mobility is likely to vary negatively with distance. This type of interaction is not easily accounted for by the theoretical arguments advanced above in which according to the framework of the human capital approach distance is given the role of moving costs. In addition, however, distance may represent uncertainty, perhaps due to lack of information. The greater is the distance to a new region the more uncertain are the income prospects of that region mainly because distance imposes a cost on information flows. If this hypothesis is correct then income differences become a less important determinant of migration with increasing distance.

Turning our attention now to the income coefficients of the net migration equation (6) it is clear that the appropriate variable to use is the simple income differential ($Y_j - Y_i$) which will then have a complex coefficient $(a_1 - a_2)(1 - k)$. Thus the fact that the income differential works well as an explanatory variable of net migration flows does not imply that it is appropriate to use this variable in explaining gross migration flows. Moreover it is difficult to draw conclusions from an observed positive relationship between net migration and income differentials. Such a relationship, which would also be affected by the proportion of return migration (k), would be compatible with any of the following cases:

- (i) gross migration is influenced by income differentials ($a_1 = -a_2$);
- (ii) income in the sender region has no effect ($a_2 = 0$);
- (iii) income in the sender region has a positive effect but smaller than income in the receiving region ($a_1 > a_2 > 0$); and
- (iv) income in the receiver region is not an attraction for migrants ($a_1 = 0$, as long as $a_2 < 0$).

As knowledge of these effects is important for purposes of mobility policies an estimated relationship between net migration and income would hide much that is of interest. Moreover, an evaluation of the rate of return on human migration can only be derived from the relationship between gross migration flows and income and distance variables.

The theoretical arguments may be concluded by stating the estimating equation which will be most important in the empirical results.

$$(7) \quad M_{ij} = (a_0 + c_0)(1+k) + (a_1 + ka_2)Y_j/D + (ka_1 + a_2)Y_i/D \\ + (a_3 + c_1)(1+k) + b_1 1/D$$

It will be noted that the gross migration flow is used as the dependent variable rather than net migration since the equation related to the latter variable hides much that is of interest. The income variables, which should both be included separately, are divided by distance to bring out the interaction between these variables. Since (7) results from combining equations similar to (1), (2) and (3) and taking the reduced form, the parameters of (7) are all complex coefficients, inter alia affected by the return migration coefficient k . The total effect of distance is, of course, expected to be negative but with a slope which becomes less negative for larger distances. The parameter in (7) relating to income in the receiving region is expected to be positive and it is anticipated that it will vary with the degree of pressure in the overall labour market. The coefficient of income in the sender region is of uncertain sign; it may also be affected by the state of the labour market.

An alternative version of equation (4) with all variables in logarithmic form is also tested in the empirical work. This version which has most of the advantages of equation (7) also has the property

that migration flows can never become negative. The main disadvantage of this form, however, is that it is more difficult to interpret the parameters than in the case of (7), because the logarithmic versions of structural equations (1) - (3) cannot easily be combined.

Alternative Theoretical Hypotheses

In a number of recent empirical studies the interregional pattern of migration has been explained in terms of employment variables.⁷ Lowry, for example, estimates a relationship in which the net change in population due to migration between metropolitan areas in the United States is largely explained in terms of the natural increase in population and the net change in employment in that area. These two variables together "explain" more than 97 percent of the variation of the dependent variable. While it is reasonable enough to argue that the natural increase in population is an autonomous event, one can surely not make the same claim for the employment change variable, which is by far the most important explanatory variable.⁸ Employment change and population change due to migration may best be seen as jointly dependent variables particularly over a long time period such as ten years. In many areas employment cannot increase unless migration takes place, and migration has, through multiplier processes, important effects on the demand for labour. Such a relationship may be useful for forecasting purposes but is grossly

⁷See Cicely Blanco, "Prospective Unemployment and Interstate Population Movements", Review of Economics and Statistics XLVI 1964, and "The Determinants of Interstate Population Movements", Journal of Regional Science Summer '63; and Ira Lowry, Migration and Metropolitan Growth: Two Analytical Models (Chandler Publishing Company, San Francisco, 1966).

⁸See Lowry, op. cit., pp. 38-45; see also Frank T. Denton's Comment on Blanco's paper and her reply in Review of Economics and Statistics XLVII, 1965. Lowry (op. cit., pp. 42-44) appears to realize that the migration-employment relation incorporates "mutual adjustments between migration and the demand for labor" (p. 44), but he is not persuaded to change his causal interpretation (p. 58).

inadequate as an analytical model.

As was indicated above, employment opportunities are likely to be important in determining migration flows, and present expectations about employment opportunities may be represented by past changes in employment. The problem is that it is difficult to pinpoint the exogenous variables which determine regional employment changes; after all this involves complicated questions of industrial location determinants. To circumvent these problems no employment change variable is included in our migration model. Since regional employment changes and regional income levels are, for good reasons, correlated with one another, the income variables used in this model may in fact partly represent differential employment opportunities. This question will be taken up below.

In the testing stage of the model two variables were included to represent differential employment opportunities viz. the regional unemployment rates and rates of natural increase of the population. Neither of these two variables is affected by the same problems which plague the employment change variable, discussed above. Both variables are, however, rejected as statistically insignificant. Rates of natural increase turn out to be quite highly correlated (negatively) with regional incomes. Part of the importance of income variables may therefore be attributable to the differential rates of natural increase.

The lack of significance of unemployment rates as an explanatory variable of migration flows may seem somewhat surprising. The problem is that areas with high out-migration viz. the Prairie provinces and the Atlantic region are at the two extremes of the unemployment spectrum, whereas between Ontario and B.C., both of which have high rates of in-migration, there is a substantial unemployment differential. There is an indirect way in which unemployment affects the empirical results viz.

the income coefficients are likely to be affected by the state of the labour market, i.e., the overall unemployment rate. This point indicates that unemployment affects the timing of migration decisions but not the direction of movement. It should be noted that regional unemployment rates are strongly affected by different levels of seasonal and frictional unemployment, which means that unemployment differentials may give a distorted picture of differential employment opportunities in the various regions. This problem does not affect the timing question since cyclical developments influence all regions in the same way.

It is concluded therefore that differential employment opportunities do not influence the direction of migration in a measurable way. Some variables are statistically not significant and others are unacceptable for theoretical reasons. This does, of course, not imply that employment opportunities have no impact on migration but simply that we have been unable to capture this impact in a reasonable way. This specification of the model has a two-fold result: (i) part of the unexplained variance of the migration variable may be attributable to omitted employment opportunity variables; and (ii) part of the measured effect of regional incomes in our model may in fact be attributable to differential employment opportunities which are correlated. Both of these elements will tend to underestimate the economic benefits of migration. The net benefit of migration consists of the income in the receiver region from which are subtracted the income in the sender region and the cost of movements, all items appropriately discounted. Now, if part of the motivation for migration results from the availability of employment in the receiver region and the lack of jobs in the sender region, then the income in the sender region should not be subtracted as foregone earnings thus raising the net benefit of migration.

Statistical Data

The migration data are derived from family allowance transfers between provinces made available by the Department of National Health and Welfare.⁹ The transfers are recorded on a monthly basis, but they are used here as annual sums over the 20-year period 1947-66. There are a total of seven regions: the Atlantic region and the remaining six provinces, which gives a total of 42 cross-section observations on migration flows. The migration data are normalized by dividing the number of family allowance transfers between two regions by the sum of the family populations of the two regions in the particular year.

Since relative regional incomes have remained stable for a long period of time the same income variables were used for each of the twenty cross-section regressions. Income is defined as annual earned income per person employed averaged over the period 1947-66. The distance variable, which is used as an inverse, is defined in terms of the number of road-miles between the main population centres of the regions. More detailed information about the statistical data is available in Appendices A and B.

Empirical Results

The various regressions for each of the 20 years are reported in Table I for equation (7). The equations using our estimated return migration variable are reported in Appendix C. The regression equations are given in the usual form; the bracketed figure below the coefficient represents its standard error.

Early tests revealed that the distance variable should be included in non-linear form, and graphical inspection suggested the use

⁹For more detailed description of migration data see J. Vanderkamp, op. cit. (Canadian Journal of Economics 1968), pp. 598-599.

of the inverse form. Equation (7)'s format, in which the income variables are divided by distance, proved to be superior to a regression equation with distance in its inverse form but with the income variables in simple linear form. In part of the test regressions simple regional dummy variables were included, e.g., for movement in and out of Quebec, which artificially improved the fit of the model. It was decided, however, to undertake a more complete analysis of the regressions residuals, which is described later in this section.

Table I
Regressions of Equation (7)

	1/D Inverse of Distance (000 miles)	Y_i/D Income Sender Region (\$000) X Distance Inverse	Y_j/D Income Receiver Region X Distance Inverse	Constant	² R
1947	-2.0192 (.4778)	.2234 (.0926)	.4490 (.0926)	.0681 (.0433)	.4891
1948	-1.7294 (.3828)	.2287 (.0742)	.3511 (.0742)	.0566 (.0347)	.5260
1949	-1.5385 (.3297)	.2199 (.0639)	.3052 (.0639)	.0405 (.0299)	.5958
1950	-1.3573 (.2764)	.2036 (.0535)	.2624 (.0535)	.0396 (.0250)	.6359
1951	-1.3094 (.3038)	.1698 (.0589)	.2853 (.0589)	.0492 (.0275)	.6207
1952	-1.4849 (.3069)	.2104 (.0595)	.3011 (.0595)	.0511 (.0278)	.6424
1953	-1.3210 (.2707)	.1921 (.0524)	.2696 (.0524)	.0403 (.0245)	.6870

Table I (cont.)

	1/D	Y_i/D	Y_j/D	Constant	R^2
1954	-1.1898 (.2623)	1.824 (.0508)	.2364 (.0508)	.0424 (.0238)	.6724
1955	-1.5194 (.3742)	.1650 (.0725)	.3654 (.0725)	.0412 (.0339)	.6169
1957	-1.14376 (.3280)	.1911 (.0636)	.3102 (.0636)	.0501 (.0297)	.6365
1958	-1.1399 (.2795)	.1862 (.0541)	.2167 (.0541)	.0385 (.0253)	.6352
1959	- .9642 (.2436)	.1507 (.0472)	.1960 (.0472)	.0314 (.0221)	.6691
1960	- .9669 (.2521)	.1634 (.0488)	.1827 (.0488)	.0316 (.0228)	.6413
1961	- .8535 (.2281)	.1526 (.0442)	.1552 (.0442)	.0318 (.0207)	.6503
1962	- .8463 (.2591)	.1412 (.0502)	.1662 (.0502)	.0364 (.0235)	.6065
1963	- .9045 (.2631)	.1255 (.0510)	.2002 (.0510)	.0388 (.0238)	.6120
1964	- .9956 (.2809)	.1337 (.0544)	.2202 (.0544)	.0445 (.0254)	.5919
1965	-1.2611 (.3548)	.1456 (.0687)	.2899 (.0687)	.0663 (.0321)	.5143
1966	-1.4203 (.3746)	.1567 (.0726)	.3310 (.0726)	.0729 (.0339)	.5326

To focus the discussion I have calculated equation (8) below in which the coefficients are simple averages over all twenty years of the parameter values reported in Table I.

$$(8) \quad M_{ij} = .0454 + .2681 Y_j/D + .1746 Y_i/D - 1.2702^1/D \quad R^2 = .611$$

The coefficients are all highly significant in each of the years. The overall fit of the equations is quite reasonable for a cross-section model. The logarithmic version of the model is on the whole slightly superior to (8), but since the coefficients are less easily interpreted in terms of the structural equations, the logarithmic equations are not shown.⁸

In equation (8) the coefficient of migration flows with respect to distance is .141, using mean incomes. In these reduced form equations both income parameters are positive but the effect of Y_j is greater than that of Y_i . To estimate the a_1 and a_2 coefficients in equation (7) we require an estimate of k . For this we turn to the RM' parameter in Table I of Appendix C. It was argued above that these RM' parameters are likely to be upward biased and to estimate the degree of bias we calculate the average RM' coefficient for the period 1 June 1956 - 1 June 1961 which was used as the base period for deriving RM' (see Appendix A). This gives us an estimate for $k = .396$ for the whole period 1947-66.⁹ Using this

⁸For purposes of this comparison a special test was used which is based on a comparison of the likelihood functions. I am grateful to my colleague John Cragg for help on this problem. It is, of course, not legitimate to choose the equation form with the highest R^2 , since the dependent variables are measured in different units. Deriving the appropriate anti-log and thus calculating an R^2 for the logarithmic form may give incorrect conclusions, since the reverse procedure might give opposite results. The Cragg-Thornber test used here derives from a comparison of the likelihood functions from which common terms have been dropped (see Hodson Thornber, 'Bayesian Inference in Distributed Lag Models', unpublished Ph.D. thesis at University of Chicago (1966), p. 41 and 42). $H(\log y)$ is preferred to $H(y)$ if $\log SE(\log y) + \overline{\log y} < \log SE(y)$ in which SE is the standard error of estimate from the relevant least squares regressions equation, and $\overline{\log y}$ is the mean of the dependent variable in the logarithmic equation.

⁹The average RM' coefficient for 1 June 1956 - 1 June 1961 is 1.466 during which period k was estimated at .399 (see Appendix A). Assuming therefore that the RM' coefficients for each year are upward biased by 46.6%, we obtain an average k for the whole period 1947-66 of .396 since the average RM' coefficient is 1.454.

estimate of k the structural income coefficients are $a_1 = .346$ and $a_2 = .081$. In words, the effect of income in the sender region on migration is positive even though not very large. This conclusion is not likely to be upset by different estimates of k ; k would in fact have to be .7 or higher to produce a negative value for a_2 with the coefficients reported in equation (8).

There is clearly a pronounced cyclical variation in the parameters reported in Table I. This is particularly so for the coefficient of the Y_j/D variable which varies from about .35 during boom years to a low of .15 in depressed periods. Part of this variation is, no doubt, attributable to fluctuations in k , the return migration coefficient, but a large part of the variation appears to be genuinely present in the structural coefficients. To show this and also to prepare the way for the discussion of the income-distance trade off in the next section, Table II is calculated based on estimates from Table I and Appendix C.

The return migration coefficient (k) is calculated with the aid of the RM' parameters of Appendix C (see footnote 9). Given these estimates of k the coefficients in the NM-equation for Y_j and Y_i can be derived from Table I. Column (4) shows the $1/D$ coefficient in the NM-equation at mean levels of incomes, assuming that the effects of distance on AM and RM may be ignored. This is not unreasonable since distance represents many problems for new migrants and probably only moving costs for persons in the other categories. If this assumption is wrong the distance coefficient in Table II is exaggerated which would mean an overestimate of the income-distance trade off.

The return migration coefficient (k) displays fluctuations similar to those of the unemployment rate, although the cyclical pattern after 1957 is less pronounced than before despite the variations in

Table II
Estimates of Structural Parameters

	Return Migration Coefficient (k)	With		
1947	.124	.428	.170	.110
1948	.160	.323	.177	.103
1949	.233	.268	.157	.107
1950	.369	.217	.124	.096
1951	.499	.267	.037	.095
1952	.401	.258	.107	.104
1953	.459	.230	.087	.106
1954	.574	.196	.070	.092
1955	.422	.237	.050	.110
1956	.201	.347	.095	.144
1957	.254	.280	.120	.129
1958	.442	.167	.112	.099
1959	.483	.161	.073	.096
1960	.498	.135	.096	.091
1961	.436	.110	.105	.091
1962	.487	.128	.079	.091
1963	.453	.180	.044	.091
1964	.524	.207	.025	.087
1965	.529	.296	-.011	.084
1966	.366	.316	.041	.098

Sources: Table I, Appendix C, and see text.

unemployment. The Y_j -coefficient (a_1), after eliminating the effect of variations in k , still has a striking cyclical pattern which has a strong negative correlation with the unemployment rate. The Y_i -coefficient (a_2) is positive but small in most of the years with the exception of 1965 when a_2 was slightly negative. The a_2 parameter has a time pattern all its own which bears little resemblance to the business cycle. The distance

coefficient -- which is in effect $(a_1\bar{Y}_j + a_2\bar{Y}_i + a_3)$, \bar{Y}_j , \bar{Y}_i being income means -- is roughly constant at about .1. Since the Y_j parameter varies and the distance coefficient is roughly constant, the trade off between income and distance will obviously differ with economic conditions.

Before proceeding to a discussion of implications we briefly consider some further empirical results. It is often argued that the populations of the more recently settled regions West of Ontario are more mobile than in the East (Ontario, Quebec and the Atlantic region). For this purpose, we may distinguish between more and less mobile groups by reference to the income and distance coefficients in our estimating equations. Thus a group is more mobile the larger is the Y_j coefficient and the smaller is the distance parameter.

To test this the data were separated in two groups: West, consisting of 24 observations relating to gross migration from each of the four Western provinces, and East, with the remaining 18 observations. Equations of the types reported in Table I and Appendix C were estimated for each of the years 1962 to 1966. Unfortunately the equations for East are of rather poor quality (with R^2 between .3 and .5) so that any generalizations which emerge are more than usually tentative. Subject to this hesitation the conclusion may be drawn that the West is indeed somewhat more mobile than the East. The effect of distance is not much different, but the Y_j parameter is larger for West than East. Return migration and autonomous movement (as judged by intercept terms) would appear to be somewhat more important in the East than in the West.

Part of the reason for the poor fit of the East equation probably stems from the special position of Quebec. One would expect that the different language and culture of Quebec will tend to reduce the amount

of interregional migration both in and out of this province. An examination of the residuals of the equations reported in Table I certainly confirms this. Virtually all residuals relating to Quebec are positive¹⁰ indicating that the equations overestimate. Most striking is the degree to which the equations overestimate the amount of migration between Ontario and Quebec.

A look at the residuals also gives some further support for the proposition that the West is more mobile than the East. The residuals for movement out of the regions of the West are largely negative while those relating to the East are predominantly positive. Moreover, the equations in Table I underestimate the amount of migration to the higher income regions in the West. The large negative residuals for Western movement to British Columbia and Alberta are very noticeable indeed.

Implications

In discussing the implications of the empirical results I shall concentrate on the trade-off between Y_j and D . Since the parameter estimates vary over time we shall use three typical cases:

- A. Parameters for the years with low unemployment (less than 4%), which includes 1947-53, 1956, and 1965-66.
- B. Parameters for the 'average' year.
- C. Parameters for years with high unemployment (more than 4%), which includes 1954-55, and 1957-64.

For each of these cases we use the estimated structural coefficients reported in Table II. This means that the trade off applies only to the new migration but this is thought to be appropriate since mobility policy

¹⁰The residuals for migration between Quebec and the Atlantic region are negative, but this is probably due to the special specification of equation (7), since these residuals largely disappear in a logarithmic specification.

is likely to be designed to affect new migration and not return or autonomous movement.

Table III shows the trade off for the three cases; it reports the number of extra Y_j dollars which are necessary to compensate for a 1,000 miles increase in distance (thus maintaining a given migration flow).¹¹

Table III

Trade Off Between Y_j and D
(in dollars per 1,000 miles)

	<u>Distance (miles)</u>			
	<u>500</u>	<u>1000</u>	<u>2000</u>	<u>3000</u>
A.	712	356	178	119
B.	840	420	210	140
C.	1088	544	272	181

N.B. Y_j is average income in region j during 1947-66.

Even though we are assuming that the effect of distance on RM and AM is small enough to be ignored, the trade off is less than it would be if the reduced form coefficients of Table I were used; e.g., the trade off implied by equation (8), which includes k in its complex coefficients, is about 25% more than case B in Table III.

Comparing cases A, B and C in Table III we notice that the trade off is much more unfavourable (about 50%) during depressed labour market conditions (case C) than when unemployment is low (case A).

¹¹ In other words it is $\frac{dY_j}{dD}$ with $dM=0$ (and also $dY_i = 0$).

$\frac{dY_j}{dD} = \frac{a_1 Y_j + a_2 Y_i + a_3}{a_1 D}$ which varies positively with income levels and negatively with distance. In Table III the variation with D is shown, and Y_j and Y_i are taken at their means (\$3188).

In other words, mobility responds much less to existing opportunities when there is general slack in the labour market. This implies that one has to be careful in applying results from a migration model fitted for any special period. It also implies that the allocative processes in the labour market are working better, and that mobility policies are likely to be much more effective when the economy is near full employment.

If, in addition, differential employment opportunities by regions are important in determining the direction of migration flows then the pay-off from migration is underestimated. It was discussed above that the income variables may to some extent incorporate the regional differences in employment prospects. In determining the benefits from migration, one would use the appropriately discounted differences between incomes in receiving and sending regions and subtract costs. If, however, employment prospects are much dimmer in the sending than in the receiving region, then the income in sender regions should not be deducted, thus raising the return to the migration process.

Although the apparent trade-offs shown above are smaller than those reported by Sjaastad,¹² they are still very large indeed. Even at high discount rates the implied costs per mile are enormous; e.g., at a 10% discount rate the earnings differential of Case B at 1,000 miles implies a cost per mile of \$4.62 at the margin. It is quite clear that this cannot be accounted for by moving and settling costs even including foregone earnings. This in turn implies that the other three elements of distance viz. psychic costs of moving, on-going preferences for nearby places, and uncertainty, must be quantitatively very important. It would be interesting but difficult to make quantitative estimates of the separate effects of these three elements.

¹²L.A. Sjaastad, op. cit., p. 84, reports that at the means the trade off is \$106(1947 -- 9 dollars) for 146 miles. Since we are using earnings figures averaged for 1947-66 which are roughly 50% more than 1947-49, this would be about \$1089 per 1,000 miles. In Table III (Case B) we show \$420 at 1,000 miles distance which is only 40% of Sjaastad's figure.

These results also imply that there is a very high potential rate of return to mobility policy. Such a policy may increase the rate of response to existing opportunities by reducing the uncertainty through information agencies, reducing the subjective risk of a migration venture, and reducing the psychic moving costs through aid with moving and settling problems, or it may in a general way subsidize migration of eligible labour force members (e.g., Canadian Manpower Mobility Program). Sjaastad argues against policies to stimulate mobility, but he concentrates entirely on the element of on-going preferences for nearby places.¹³ If we admit the importance of the other two elements represented by distance then this argument is clearly no longer valid. The high potential rate of return suggests that over-investment in mobility policies is not a very likely event.

¹³L.A. Sjaastad, loc. cit.

Appendix A

The Calculation of Estimated Return Migration

In the second section of the paper the problem of simultaneity is discussed as introduced by the phenomenon of return migration. The estimating equation (7) which is derived at the end of the theoretical discussion can be seen as a reduced form equation. In this appendix an alternative form of estimating equation is derived in which an estimate of return migration is used as an explanatory variable.

Using a simplified version of equation (2) above (leaving out the distance variable) we may write

$$(A-1) \quad RM_{ij} = k_{ij}(NM_{ji} + AM_{ji})$$

$$(A-2) \quad RM_{ji} = k_{ji}(NM_{ij} + AM_{ij})$$

We furthermore have the following definitional identities

$$(A-3) \quad M_{ij} = NM_{ij} + RM_{ij} + AM_{ij}$$

$$(A-4) \quad M_{ji} = NM_{ji} + RM_{ji} + AM_{ji}$$

Since none of the components of these migration flows are directly measurable, we have to express return migration flows in terms of total migration flows. It is assumed that the return migration coefficients are identical for migration flows in opposite directions although they may be different between different pairs of regions; or formally

$$(A-5) \quad (k =) k_{ij} = k_{ji}, \quad \text{but } k_{ab} \neq k_{ij}$$

From equations (A-1) and (A-4) we obtain

$$(A-6) \quad RM_{ij} = kM_{ji} - kRM_{ji}$$

Subtracting kRM_{ij} from both sides of (A-6) we obtain

$$(A-7) \quad RM_{ij} = \frac{k}{1-k} M_{ji} - \frac{k}{1-k} (RM_{ij} + RM_{ji})$$

Summing (A-1) and (A-2) we obtain

$$(A-8) \quad RM_{ij} + RM_{ji} = \frac{k}{1+k} (M_{ij} + M_{ji})$$

Substituting (A-8) in (A-7) and rearranging gives us

$$(A-9) \quad RM_{ij} = \frac{k}{1-k^2} M_{ji} - \frac{k^2}{1-k^2} M_{ij}$$

This equation brings out the simultaneity between migration flows in opposite directions and we can write the two simultaneous equations as follows:

$$(A-10) \quad M_{ij} = (1-k^2)(NM_{ij} + AM_{ij}) + kM_{ji}$$

$$(A-11) \quad M_{ji} = (1-k^2)(NM_{ji} + AM_{ji}) + kM_{ij}$$

To obtain estimates of return migration we use the Census-Family Allowance comparison made in a previous paper ("Interregional Mobility in Canada: A Study of the Time Pattern of Migration", Canadian Journal of Economics 1 No. 3, August 1968). The family allowance data on migration used in this study are based on monthly transfers between provinces, while the migration information in the 1961 Census of Canada relates to changes of residence over a five-year period. This means that the census data on migration exclude all return migration within the 5-year period. Using the average difference between the two sets of data (averages of columns (3) and (7) of Table I in paper in Canadian Journal of Economics) we can estimate total return migration between any two pairs of regions over the 5-year period ($RM_{ij} + RM_{ji}$). Again summing (A-1) and (A-2) we obtain our estimate of k (called k')

as follows

$$(A-12) \quad k' = \frac{(RM_{ij} + RM_{ji})}{(M_{ij} + M_{ji}) - (RM_{ij} + RM_{ji})}$$

In (A-12) $(RM_{ij} + RM_{ji})$ is the difference between the two sets of data and $(M_{ij} + M_{ji})$ is the sum of migration flows between a pair of regions using the family allowance statistics. The estimate k' will be different for every pair of regions and these differences are likely to be the result of distance, economic similarities and cultural affinities of the regional populations. The average k' value for all regions is .399.

Using this estimate k' and equation (A-9) we can now estimate a coefficient α_{ij} which expresses the return migration from i to j as a proportion of the total migration flow from j to i .

$$(A-13) \quad \alpha_{ij} = \frac{RM_{ij}}{M_{ji}} = \frac{k'}{1 - k'^2} = \frac{k'^2}{1 - k'^2} \frac{\bar{M}_{ij}}{\bar{M}_{ji}}$$

in which \bar{M}_{ij} and \bar{M}_{ji} are the average migration flows between the two regions i and j during the period 1956-61; the average value of the α -coefficient for all regions is about .28. With these coefficients, which are given in Table A-1, we can now define our estimate of return migration (RM'_{ij}) as

$$(A-14) \quad RM'_{ij_t} = \alpha_{ij} M_{ji_{t-1}}$$

using the total migration flow in the opposite direction during the previous year.

The estimating equation then becomes (using the income-distance interaction variables as in equation (7) of the second section)

$$(A-15) \quad M_{ij} = (a_0 + c_0) + a_1 \frac{Y_j}{D} + a_2 \frac{Y_i}{D} + (a_3 + c_1) 1/D + b_2 RM'_{ij}$$

Table A-1

Estimates of α coefficients, i.e., return migration
as proportion of total migration in the
opposite direction.

<u>From</u>	<u>To</u>	<u>ij</u>	<u>ji</u> (applies to opposite direction)
Alberta	B.C.	.256	.366
Saskatchewan	B.C.	.175	.374
Manitoba	B.C.	.184	.341
Ontario	B.C.	.239	.254
Quebec	B.C.	.246	.255
Atlantic	B.C.	.269	.320
Saskatchewan	Alberta	.178	.338
Manitoba	Alberta	.219	.305
Ontario	Alberta	.261	.260
Quebec	Alberta	.209	.217
Atlantic	Alberta	.236	.262
Saskatchewan	Manitoba	.280	.299
Saskatchewan	Quebec	.190	.200
Saskatchewan	Atlantic	.227	.226
Saskatchewan	Ontario	.243	.292
Manitoba	Ontario	.271	.296
Manitoba	Quebec	.202	.283
Manitoba	Atlantic	.276	.315
Quebec	Ontario	.255	.305
Atlantic	Quebec	.244	.338
Atlantic	Quebec	.253	.354

If the true proportion of return migrants varies with economic conditions then we expect the b_2 -coefficient to vary in the same fashion. Moreover, if the amount of return migration from 1956 to 1961 was typical for the whole post-war period then we expect the estimate of b_2 to average unity.

Estimating equation (A-15) formally avoids the simultaneous equation problem encountered in equations (A-10) and (A-11) above.

But as (A-14) shows the estimate of return migration is still indirectly derived from the migration flow in the opposite direction. Thus there are serious doubts about equation (A-15) which is the reason that the estimating results for this equation are relegated to Appendix C. One would expect the b_2 coefficient in (A-15) to be upward biased as a result of the simultaneity which remains.

Appendix B

Statistical Data

The migration data are already briefly described in section 4 of the paper. For a more detailed evaluation see J. Vanderkamp, "Interregional Mobility in Canada: A Study of the Time Pattern of Migration", Canadian Journal of Economics I No. 3, August 1968, and Y Kasahara, "The Flow of Migration Among Provinces in Canada, 1951-1961" in Wm. C. Hood and J.A. Sawyer (eds.), Conference on Statistics 1961 (Toronto, 1963). Migration flow M_{ij} is defined as the number of family allowance transfers (annual sums of monthly records) from region i to region j as a percentage of the sum of the family populations in regions i and j on June 1 of the particular year. These statistics are not published but were made available to me by the Canada Department of National Health and Welfare's Family Allowance Division. The migration data are available from the author on request.

The income data are derived from the personal income statistics of the National Accounts, Income and Expenditure, Dominion Bureau of Statistics, Ottawa. Only those components of personal income were included in which earned income is associated with location, i.e., wages and salaries, net farm income, and net income from non-farm unincorporated businesses. Other forms of personal income such as income transfers, interest and dividends are excluded since they are not related to the place of residence of the recipient. The income variable Y_j is therefore defined as the average annual earned income per person employed in region j averaged over the period 1947-66 expressed in thousands of dollars.

Employment and unemployment data are directly derived from DBS, Labour Force Survey (monthly); see particularly March 1965 supplement. For the three individual Prairie provinces these data are estimated using the Census of Canada for 1951 and 1961, annual population estimates, and the Labour Force Survey. Rates of natural increase per 1000 of population are derived from DBS, Vital Statistics 1964. Since labour force entry takes place from age 15 on the annual rates of natural increase were averaged over the period 1931-1950.

Distance is measured as the number of road-miles (in thousands) between the main population centers of the regions. These data were supplied by the Canadian Automobile Association.

The definition of estimated return migration can be obtained from Appendix A.

Appendix C

Regressions of equation (A-15)

Table C-1

	1/D	Y_i/D	Y_j/D	RM ¹	Constant	R ²
	Inverse of Distance (000 miles)	Income (\$000) Sender Region x Distance Inverse	Income (\$000) Receiver Region x Distance Inverse	Return Migration Estimate		
1947	-1.6674 (.5737)	.1460 (.1160)	.4108 (.0986)	.4562 (.4144)	.0564 (.0444)	.5053
1948	-1.3370 (.4327)	.1344 (.0895)	.3156 (.0748)	.5878 (.3301)	.0437 (.0345)	.5634
1949	-1.0808 (.3617)	.1138 (.0740)	.2584 (.0630)	.8552 (.3486)	.0257 (.0287)	.6524
1950	-.7261 (.2665)	.0593 (.0544)	.1916 (.0465)	1.3538 (.3034)	.0244 (.0207)	.7633
1951	-.5891 (.3006)	.0049 (.0617)	.2031 (.0521)	1.8339 (.4227)	.0290 (.0232)	.7486
1952	-.8958 (.3011)	.0608 (.0633)	.2471 (.0524)	1.4739 (.3747)	.0299 (.0243)	.7478
1953	-.5528 (.2248)	.0111 (.0465)	.1874 (.0389)	1.6869 (.2651)	.0155 (.0176)	.8505
1954	-.3724 (.2007)	-.0155 (.0420)	.1495 (.0346)	2.1101 (.2832)	.0183 (.0156)	.8690
1955	-.5953 (.2953)	.0185 (.0610)	.1966 (.0518)	1.5500 (.4306)	.0174 (.0235)	.7384
1956	-1.2490 (.4192)	.0951 (.0879)	.3402 (.0740)	.7394 (.5389)	.0331 (.0340)	.6354

Table C I (continued)

	1/D	Y_i/D	Y_j/D	RM ¹	Constant	R ²
1957	- .9763 (.3454)	.0684 (.0735)	.2736 (.0601)	.9343 (.3373)	.0378 (.0278)	.6989
1958	- .4230 (.2302)	.0069 (.0482)	.1477 (.0401)	1.6220 (.2628)	.0150 (.0184)	.8203
1959	- .3730 (.1989)	.0134 (.0404)	.1247 (.0356)	1.7760 (.2897)	.0128 (.0160)	.8358
1960	- .4476 (.2225)	.0347 (.0460)	.1252 (.0399)	1.8278 (.3640)	.0163 (.0181)	.7866
1961	- .3952 (.2013)	.0462 (.0407)	.0983 (.0365)	1.6015 (.3219)	.0181 (.0164)	.7905
1962	- .3960 (.2443)	.0386 (.0491)	.1070 (.0447)	1.7882 (.4378)	.0213 (.0201)	.7288
1963	- .4716 (.2327)	.0204 (.0471)	.1492 (.0427)	1.6651 (.3625)	.0223 (.0196)	.7529
1964	- .4596 (.2362)	-.0078 (.0492)	.1705 (.0425)	1.9257 (.3604)	.0230 (.0198)	.7697
1965	- .6627 (.3327)	-.0103 (.0693)	.2351 (.0594)	1.9448 (.4768)	.0409 (.0278)	.6649
1966	- .8730 (.3740)	.0144 (.0781)	.2863 (.0662)	1.3460 (.4119)	.0464 (.0313)	.6373